A Multi-Algorithm, High Reliability Steganalyzer Based on Services Oriented Architecture

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Abstract

In this prospectus we are proposing to develop a unified Steganalyzer that can not only work with different media types such as images and audio, but further is capable of providing improved accuracy in stego detection through the use of multiple algorithms running in parallel. Our proposed system integrates different steganalysis techniques in a reliable Steganalyzer with distributed and Services Oriented Architecture (SOA). The distributed architecture not only allows for concurrent processing to speed up the system, but also provides higher reliability than reported in the existing literature. The extendable nature of the SOA implementation allows for easy addition of new Steganalysis algorithms to the system in terms of services.

The universal steganalysis technique proposed in this prospectus involves two processes; feature extraction and feature classification. Three methods are used for feature extraction; Mel-Cepstrum and Markov (for audio), and Intra-blocks for (JPEG images). The feature classification process is implemented using neural network classifier. The unified steganalyzer is tested for JPEG images and WAV audio files. The accuracy of classification ranges from 96.8% to 99.8% depending on the object type and the feature extraction method. In particular, an enhancement of Mel-Cepstrum technique is proposed that achieves an accuracy of 99.8%. This is significantly better than detection accuracy of 89.9% to 98.6% [Liu 2011] where even a much larger training dataset was used than ours.

Steganalysis

It is the art of discovering invisible communication

Clean image

Stego image

Universal Steganalysis

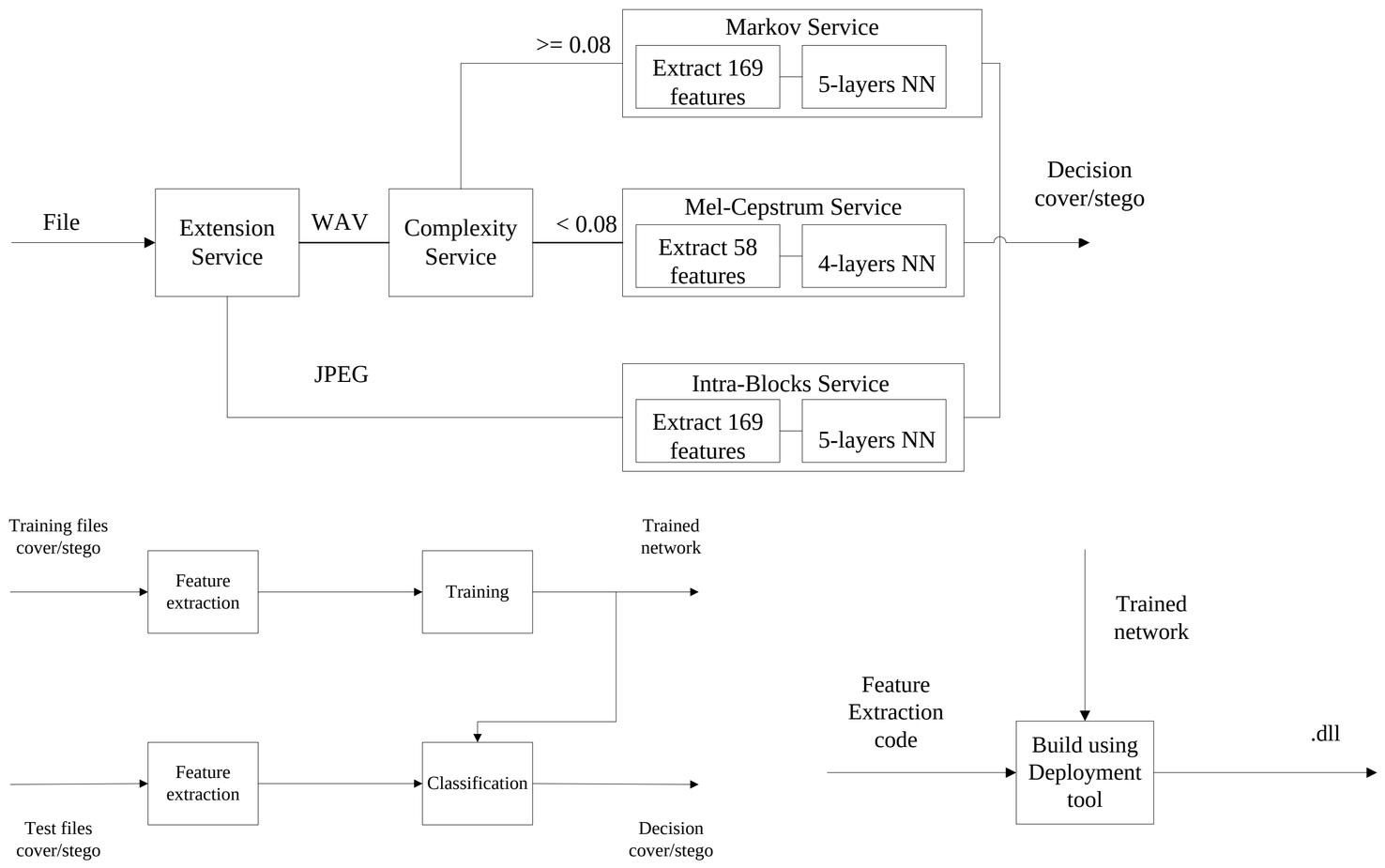
Feature extraction:

A set of distinguishing statistics is obtained from the object

Feature classification:

- Training
- Testing

Overview of the Services Oriented Architecture Steganalyzer

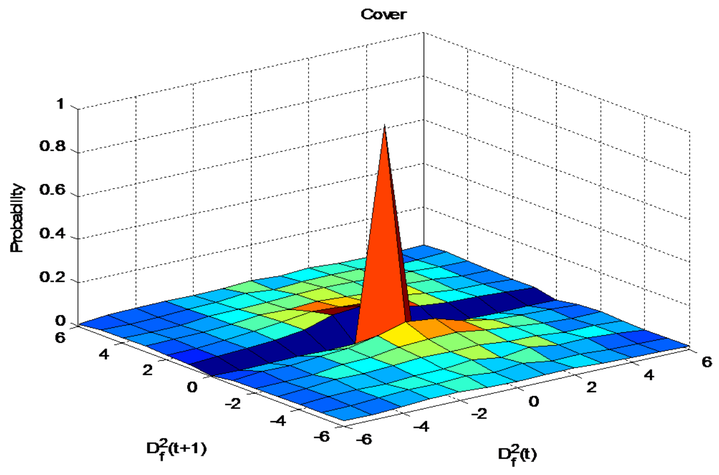


Services

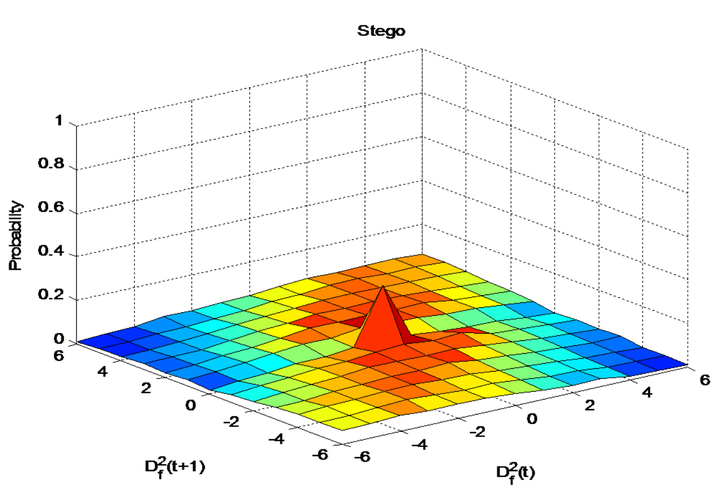
- Extension Service
- Complexity Service
- Mel-Cepstrum Service
- Markov Service
- Intra-Blocks Service

Markov Services

$$M_{D_f^2}(i,j) = \frac{\sum_{t=1}^{N-3} \delta(D_f^2(t) = i, D_f^2(t+1) = j)}{\sum_{t=1}^{N-3} \delta(D_f^2(t) = i)}$$



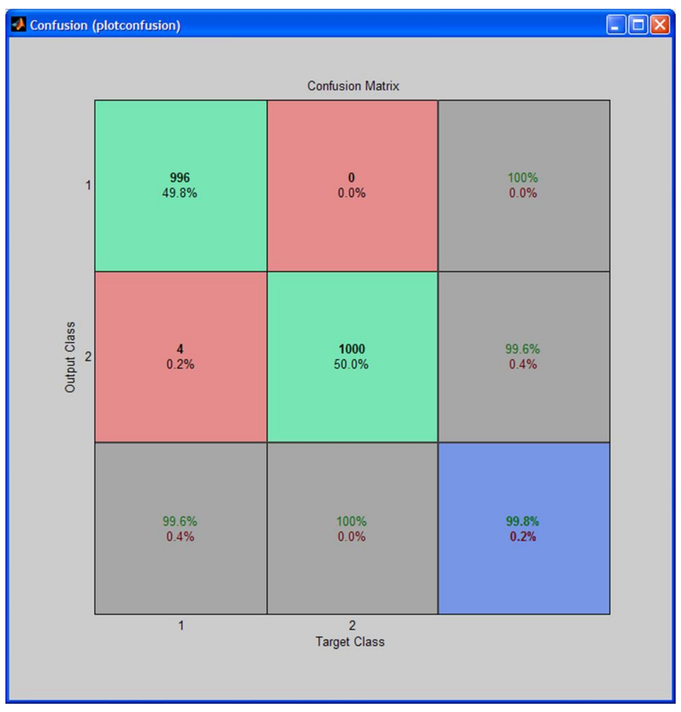
Markov transition probability of the second order derivative (Cover wave)



Markov transition probability of the second order derivative (Stego wav)

Results

- Intra-Blocks Service: 98.9% accuracy
- Markov Service: 96.8% accuracy
- Mel-Cepstrum Service: 99.8% accuracy



Classification confusion matrix for 1000 wav files

Conclusion

- Implemented a multi-algorithm, high reliability steganalyzer based on Services Oriented Architecture:
  - The implemented steganalyzer is scalable, allowing the addition of new services to integrate other steganalysis algorithms
  - The steganalyzer supports concurrent processing which enhances its speed
  - Currently supports JPEG and WAV types
- Universal (blind) steganalysis techniques are implemented
- A multi-stage neural network classifier is designed for each technique that achieves reliable results